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Adoption of Integrated Pest Management (IPM) Practices in Flue Cured Virginia Tobacco Crop

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Abstract: Integrated pest management (IPM) study on the adoption of improved farm practices and regimes adopted by the farmers growing Flue Cured Virginia (FCV) tobacco in the target area was completed during the harvest season of tobacco crop. In case of crop production the adoption rates of FCV growers for line sowing, cropping pattern of maize-tobacco-maize-tobacco for 2 years, removal of tobacco stalks through kudal, keeping row to row distance 3 feet, plant to plant distance 2 feet, application of chemical fertilizer, chemical control adopted, spraying effectiveness, duration of irrigation (after 7 days), number of irrigation only one time and better sanitation of store houses adopted by the farmers (FCV growers) are as 100 %, 72 %, 100 %, 78 %, 72 %, 100 %, 100 %, 100 %, 80 %, 100 % and 58 % respectively are encouraging, while the adoption rate of the same farmers for land preparation by mould board plough, number of ploughing (5 ploughs), use of well decayed farm yard manure, source of FYM as a dung of animals, number of leaves per plant (22 leaves), best sanitation and best ventilation of the store houses recorded as 34 %, 38 %, 32 %, 48 %, 46 %, 12 % and 12 % respectively, are not up to the standard and needs further improvement if the extension service has made available to these farmers by Pakistan Tobacco Company (PTC) to train them in the improved practices of integrated pest management.

Key words: Integrated Pest Management · Tobacco Crop · Improved Farm Practices

INTRODUCTION

The integrated pest management (IPM) is an approach that maximizes natural control of pest population and utilizes man initiated action only when it is extremely probable that a pest population will exceeds an economic injury level [1]. IPM is the selections, integrations and the implementation of pest's control which is based on the predicted economics, ecological and sociological consequences [2].

IPM is usually referred as a "crop protection/pest management system" with allegation used for both of the methodologically and disciplinary combination in the socio economic framework of farming system. IPM is a sustainable agriculture approaches with a sound ecological foundations. It is usually targeted against the complete pest complex of an agro ecosystem [3]. IPM Pest allows the farmers in protection of their crops from different types of pests. IPM also gives protection to soil, water, wild life, beneficial insects and the community. Most of the scientific literatures showed that the practices of IMP improve the environmental performance and effective pest control [4].

The integrated control is a management system of pest population that utilizes all appropriate technique either to decrease pest population and keep them at a

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level below those causing economic injuries or to control the population to prevent them from such types of injuries [5]. IPM, involve the carefully control use of an array of pests controls tactics that include cultural, chemical and biological methods to achieve the finest result with the minimum disruptions of the environment [6].

The sustainability of the traditional agriculture has been encouraged extensive introduction of IPM, ecological based approaches for the controlling of damaging weeds and insects [7]. IPM is planned to decrease health and ecological damages from chemical pesticide by using the natural predators and parasites in order to control pest's populations.

Four Simple Steps Comprise the IPM Program:

- Set Action Threshold - Before choosing an action, determine if there really is a problem. For example, if there is only one tomato hornworm, pick it off the plant to avoid using chemicals.
- Monitor and Identify Pests - Accurate identification of "pests" will determine the need for chemicals. Many beetles, bugs and weeds do not require chemical use because many do not cause problems. Actually, many beetles are "good guys."
- Prevention - In an IPM program, implement other controls before chemicals. Changing the time of watering, planting vegetables in different spots each year and choosing appropriate plant varieties are examples of preventative actions. These do not require extensive changes or financial input.
- Control - If action is required after steps 1-3, evaluate the various forms of control to determine the least risky. Using pheromones to interrupt the mating cycle, weeding or trapping, may be effective and have no bad effects. Specifically targeted chemicals affecting specific pests would be the next to the last resort. The goal is to avoid broadcast spraying of non-specific chemicals.

With these steps, IPM is best described as a continuum. Many, if not most, agricultural growers identify their pests before spraying. A smaller subset of growers uses less risky pesticides such as pheromones. All of these growers are on the IPM continuum. The goal is to move growers further along the continuum to using all appropriate IPM techniques.

MATERIALS AND METHODS

The aim of the current study was to find out the adoption rate of the recommendations given by the Pakistan Tobacco company leaf department in the integrated pest management regimes in the tobacco crop production to the focused group of farmers, which are the agreement holders of Pakistan Tobacco Company.

We have developed a protested questionnaire with the help of leaf department of PTC which was used for the data collection. In this project data was collected from chakdarra area of district Dir and Shergarh area of district Mardan, where about 50 farmers in 20 villages were interviewed and their fields were examined and the data were analyzed in accordance with the following procedure at 90% confidence level to determine the adoption rate of the general farmers in the integrated pest management regimes and principles in the target area.

$$D = \sqrt[K]{\frac{P(1-P)\times[1+d(m-1)]}{n}}$$

where,

D = Confidence Level Value

K = 1.64 (Constant for 90% Confidence Level)

D = 0.2 (constant)

$$M = \frac{\text{Total Number of Farmers}}{\text{Total Number of Villages}}$$

N = Total Number of Farmers (Respondents)

$$P = \frac{\text{No. of respondents for Specific Activities x 100/100}}{\text{Total surveyed farmers (Respondents)}}$$

Upper and Lower confidence level are worked out as below;

Upper Confidence level = (P + D) x 100

Lower Confidence level = (P – D) x 100

RESULTS

Improved Crop Production Practices in Field: The techniques adopted by the farmers for the raising of Tobacco crop production have been presented in Table 1. It is evident from the table that 34 %, 34 % and 32 % of the farmers are owners, tenants and owner cum tenants and the adoption rate of owners, tenants and owner cum tenants of the general farmers in the target

Table 1: Sample Mean, Lower and Upper Confidence Level in the adoption of improved practices in the production of Tobacco crop

Improved Practices in Field	Sample Mean	Lower Confidence Level	Upper Confidence Level
Tenancy status			
Owner	34	21.47	46.53
Tenant	34	21.47	46.53
Owner Cum tenant	32	19.66	44.33
Land Preparation by			
Mould Board Plough	34	21.47	46.53
Cultivator	36	0.47	15.17
Row rider	6	-0.28	12.28
Bullock draw harrow	12	3.41	20.59
Rotavator	12	3.41	20.59
Number of Ploughing			
3 Ploughs	8	0.82	15.17
4 Ploughs	34	21.47	46.53
5 Ploughs	38	25.16	50.83
6 Ploughs	18	7.84	28.16
7 Ploughs	2	-1.70	5.70
Method of Sowing			
Line	100	100	100
Other	0	0	0
Cropping pattern (for 2 years)			
Maize- Tobacco-Maize-Tobacco	72	60.13	83.87
Sugarcane-Tobacco-Maize	16	6.30	25.69
Vegetables-Tobacco-Vegetables-Tobacco	12	3.41	20.59
Removal of tobacco stalk			
Through Kudal	100	100	100
Other	0	0	0
Uses of tobacco stalk			
Used as a fuel	100	100	100
Any other used	0	0	0
Row to row distance in feet			
3 Feet	78	67.04	88.95
3.25 Feet	2	-1.70	5.70
3.50 Feet	20	27.04	52.95
Plant to plant distance in feet			
2 Feet	72	60.13	83.87
2.25 Feet	4	-1.18	9.18
2.50 Feet	16	6.30	25.69
3 Feet	8	0.82	15.17
After Topping/Suckering number of leaves/plant			
19 leaves	2	-1.70	5.70
20 leaves	20	27.04	52.95
21 leaves	10	-1.63	3.63
22 leaves	46	32.82	59.18
23 leaves	8	0.82	15.17
24 leaves	10	-1.63	3.63
25 leaves	4	-1.18	9.18

areas of Chakdarra and Shergarh ranged between 21.47-46.53 %, 21.47-46.53 % and 19.66-44.33 % at 90 % confidence level respectively. 34 % of the respondents are preparing their lands by mould board plough, 36 % by cultivator, 6 % by row ridger, 12 % by Bullock drawn barrow and 12 % by using rotavator, while the adoption rate of the general farmers for using mould board plough, cultivator, row ridger, Bullock drawn harrow and rotavator ranged between 21.47-46.63 %, 0.82-15.17 %, -0.28-12.28 %, 3.41-20.59% respectively.

Of the respondents (8 %, 34 %, 38 %, 18 % and 2 %) are doing three passes of ploughing, four passes of ploughing, five passes of ploughing, six passes of ploughing and seven passes of ploughing, while the

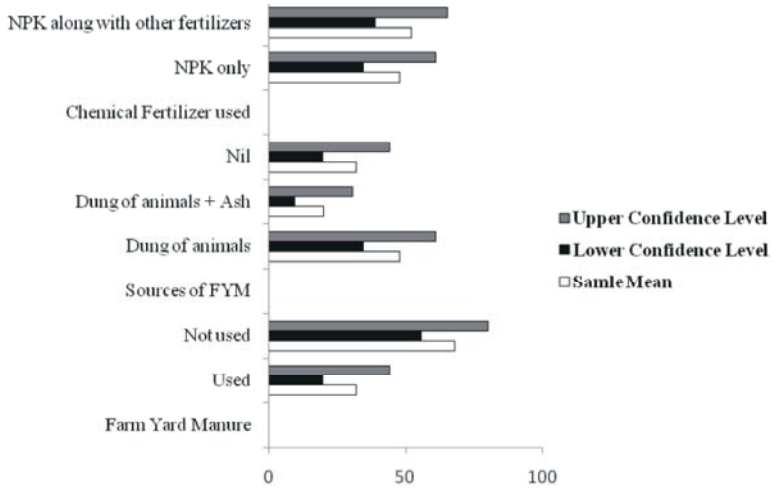

Fig. 1: Sample Mean, Lower and Upper Confidence Level in the adoption of improved practices (Farm Yard Manure and Chemical Fertilizers) in tobacco crop

adoption rate of the general farmers for three passes of ploughing, four passes of ploughing, five passes of ploughing, six passes of ploughing and seven passes of ploughing ranged between 0.82-15.17 %, 21.47-46.53 %, 25.16-50.83 %, 7.84-28.16 % and -1.71-5.71 % respectively. 100 % of the respondents have adopted line sowing in their fields. 72 % of the respondents have adopted cropping pattern of maize-tobacco-maize tobacco, 16 % adopted cropping pattern of sugarcane-tobacco-maize and 12 % adopted cropping pattern of vegetables-tobacco-vegetables-tobacco for the period of two years, while the adoption rate of the general farmers for these three cropping pattern ranged between 60.13-83.87 %. Maximum respondents (46 %) did topping/suckering when tobacco plant has 22 leaves.

The Use of Farm Yard Manure and Chemical Fertilizers: Farm Yard Manure and chemical fertilizers used by respondents is given in Figure 1. FYM was used by 32 % of the respondents in their fields while 68 % of the respondents have not used FYM in their fields and the adoption rate of the general farmers ranged between 19.66-44.33 % and 55.66-80.33 % respectively. 48 % of the respondents have used dung of animals as their FYM, 20 % of the respondents have used dung of animals as well as ash in their FYM and 32 % of the respondents have not used any source of FYM, while the adoption rate of the general farmers ranged between 34.79-61.12 %, 9.42-30.58 % and 19.66-44.33 % respectively. 48 % of the respondents used only NPK fertilizer in their fields and 52 % of the respondents used NPK along with other fertilizers in their fields and the adoption rate of the general farmers ranged between 34.79-61.12 % and 38.79-65.21 % respectively. Considerable experiments have carried out by Pakistan Tobacco Company and have found that Nitrogen, Phosphorus and Potassium which are the primary nutrients are required essentially to the tobacco crop in a balanced way which is explained in Table 2.

Table 2: Major and minor nutrient requirements of tobacco crop

Nutrients (for 2000 kgs production)	Kgs/hectare
Nitrogen	70
Phosphorus	80
Potassium	80
Calcium	55
Magnesium	22
Sulphur	18
Boron	0.07
Copper	0.04
Iron	Trace
Zinc	Trace
Molybdenum	Trace

Observation of Tobacco Insect Pests and Diseases: Insect pests and diseases of tobacco crop were observed in fields as mentioned in Table 3. Maximum respondents (62 %) have observed mole cricket in their fields and 38 % of the respondents have not observed mole cricket in their fields, while the same insect pest in the fields of the general farmers ranged between 49.16-74.83% and 25.16-50.83 % respectively. Cutworm was observed by 66 % of the respondents in their fields while 34 % of the respondents have not observed cutworm in their fields, while the same insect pest in the fields of the general

Table 3: Sample Mean, Lower and Upper Confidence Level observed in insect pests and diseases of tobacco crop

Insect pests and diseases in field	Samle Mean	Lower Confidence Level	Upper Confidence Level
Mole cricket in field			
Observed	62	49.16	74.83
Nil	38	25.16	50.83
Cut worm in field			
Observed	66	53.47	78.53
Nil	34	21.47	46.53
Bud worm in field			
Observed	50	36.78	63.22
Nil	50	36.78	63.22
Aphids in field			
Observed	80	69.42	90.58
Nil	50	9.42	30.58
Termites in field			
Observed	24	12.71	35.29
Nil	76	64.71	87.29
Brown spot disease in field			
Observed	38	25.16	50.83
Nil	62	49.16	74.83
Black shank disease in field			
Observed	8	0.82	15.17
Nil	92	84.82	99.17
Side crops			
Sugarcane	24	12.71	35.29
Wheat	12	3.41	20.29
Tobacco	60	47.08	72.95
Maize	4	-1.18	9.18
Insect pests of side crops			
Transferred to the main crops (Tobacco)			
Termite	10	-1.63	3.63
Armyworm	06	-0.28	12.28
Grasshopper	04	-1.18	9.18
Nil	80	69.42	90.58
Disease of side crops to the main crops (Tobacco)			
Brown spot disease	8	0.82	15.17
Black shank disease	2	-1.70	5.70
Nil	90	82.07	97.93

farmers ranged between 53.47-78.53 % and 21.47-46.53 % respectively. 50 % of the respondents have observed Budworm in their fields and 50 % of the respondents have not observed Budworm in their fields, while the same insect pest in the fields of the general farmers ranged between 36.78-63.22 % and 36.78-63.22 % respectively. 80 % of the respondents have observed Aphids in their fields and 20 % of the respondents have not observed Aphids in their fields, while the same insect pest in the fields of the general farmers ranged between 69.42-90.58 % and 9.42-30.58 % respectively. 24 % of the respondents have observed termites in their fields and 76 % of the respondents have not observed termites in their fields, while the same insect pest in the fields of the general farmers ranged between 12.71-35.29 % and 64.71-87.29 % respectively.

Brown spot disease was observed by 38 % of the respondents while 62 % of the respondents have not observed Brown spot disease in their fields, while the same disease in the fields of the general farmers ranged between 25.16-50.83 % and 49.16-74.83 % respectively. 8 % of the respondents have observed Black shank disease in their fields and 92 % of the respondents have not observed Black shank disease in their fields, while the same disease in fields of the general farmers ranged between 0.82-15.17 % and 84.82-99.17 % respectively. 100 % of the respondents have adopted chemical control against insect pests and disease.

Table 4: The recommended ingredients of pesticides used by the farmers in the target areas

Active ingredients	Product	Packing	Formation type	Application rate in the field	Target insect pests and disease
Cypermethrin	Cypermethrin (universal agrochem)	250 ml	10 EC	500 ml/hec	Mole cricket, cutworm and budworm
	Cyperkil (R.B Avari)				
	Ripcard (Cynamid)	250 ml	10 EC	250 ml/acre	-do-
	Sherpa (Rhone-Polenc)	250 ml	10 EC	500 ml/hec	-do-
	Larsban (dow elanco)	500 ml	25 SL	500 ml/acre	-do-
	Syren	1000 ml	40 CC	400-500 ml/acre	
		250 ml	10 EC	250 ml/acre	Mole cricket, cutworm and termite. Mole cricket, cutworm and budworm
Methamedo-phos	Tamaron (Bayer)	1000 ml	600 SL	400-500 ml/acre	Aphid
	Methamedoph-os (F.M.C)	500 ml	50 SC	500 ml/acre	-do-
	Chaser (Redex)	500 ml	25 SC	500 ml/acre	-do-
Methymyl	Lannate (Du pont)	250 gms	40 SP	625 gms/hec	Mole cricket, cutworm and budworm
Thiodicarb	Larvin (Rhone-Poulenc)	100 gms	80 DF	225-250 gms/acre	Budworm
Chlorpyrifos	Larsban (Dow Agro sciences)	250 ml	40 EC	250 ml/acre	Mole cricket, cutworm and termite
Deltamethrin+ Dimethoate	Decis D(Agro Evo)	1000 ml	35 EC	2-2.5 lit/hec	Mole cricket, cutworm, budworm and aphid
Biphenthrin	Talstar (F.M.C)	1000 ml	10 EC	400-500 ml/acre	Budworm and termite
Endosulfan	Thiodan (Edgro)	1000 ml	35 EC	2-2.5 lit/acre	Mole cricket, cutworm and termite
Carbaryl	Sevin Dust (Carbide)	5 kg	10 D	12.5 kg/hec	Cutworm and budworm
Metalaxil	Ridomil (Lobartis)	1000 gms	72 WP	200-250 gms/acre	Brown spot disease

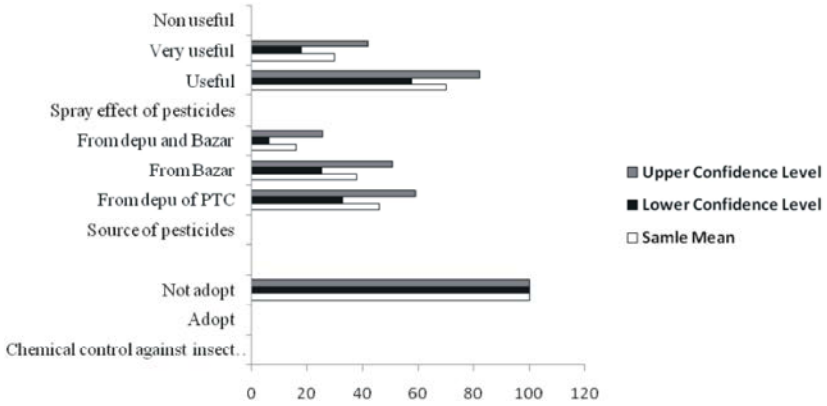

Fig. 2: Sample Mean, Lower and Upper Confidence Level in the adoption of chemical control against insect pests and diseases of tobacco crop

Adoption of Chemical Control: All respondents have adopted chemical control against insect pests and diseases as mentioned in Figure 2. About 70 % respondents have observed the effect of chemicals spray in their fields as a useful strategy to control insects pests and diseases, 30 % found very useful and no one have found the effect of spray as non useful, while the adoption rate of the general farmers ranged between 57.88-82.12 %, 17.88-42.12 % and 0 % respectively. 46 % respondents get pesticides from depu of PTC, 38 % obtained pesticides from bazar while 16 % of the respondents obtained pesticides from depu and bazar. Table 4 explains the recommended ingredients of pesticides used by the farmers (FCV growers) in the target areas of Chakdarra and Shergarh on tobacco crop.

Irrigation Practices: Irrigation practices adopted by respondents are given in Figure 3. 4 % of the respondents are giving irrigation to their fields 4-5 days after, 80 % of the respondents are giving irrigation to their fields after 7 days and 16 % of the respondents are giving irrigation more than 7 days after, while the adoption rate of the general farmers r anged between -1.18-9.18%, 69.42-90.58 % and 6.30-25.69 % respectively. 100 % of the respondents have flooded their fields by irrigation only one time. 50 % of the respondents are using tubewel water for irrigation purpose and 50 % of the respondents are using river water for irrigation purpose, while the adoption rate of the general farmers ranged between 36.78-63.22 % and 36.78-63.22 % respectively.

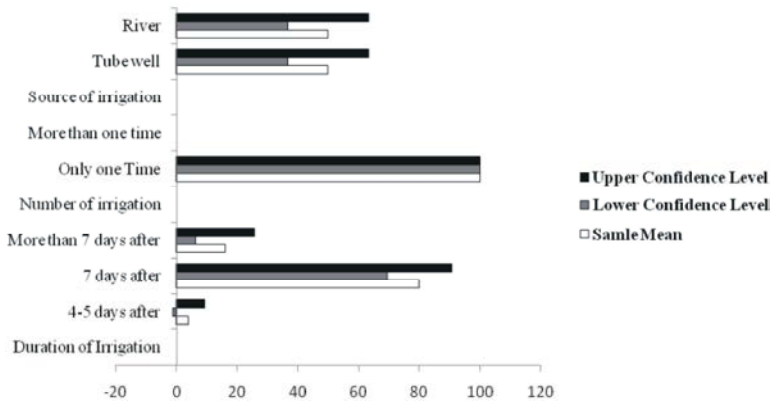

Fig. 3: Sample Mean, Lower and Upper Confidence Level in the adoption of irrigation practices in tobacco field

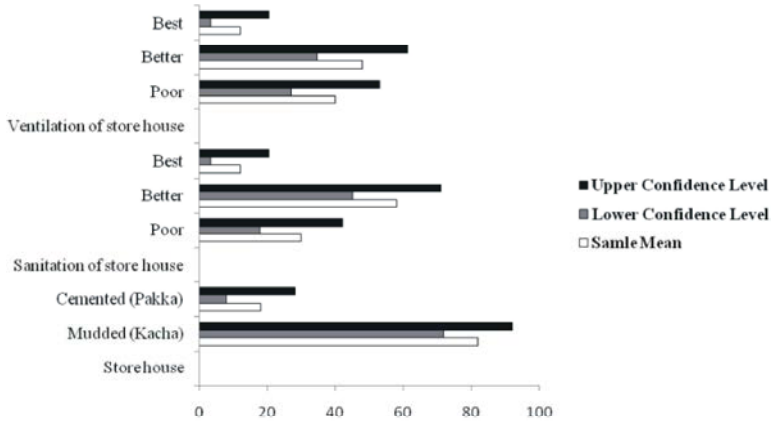

Fig. 4: Sample Mean, Lower and Upper Confidence Level in the adoption of sanitation and ventilation practices in tobacco store house

Tobacco Store Houses: Maximum respondents (82 %) have stored the bundles of dried tobacco leaves in mudded store houses as shown in Figure 4. Only 12 % respondents have adopted best sanitation and ventilation measures in their store houses.

DISCUSSION

Preparation and Cultivation of Land: Proper preparation is one of the main factors contributing to yield and quality of tobacco. Therefore, land should be thoroughly prepared, leveled and cultivated several times to produce proper tilth. In Chakdarra and Shergarh areas tobacco crop follows maize and sugarcane, so the first preparatory ploughing must be given by mould board plough to pulverize the soil in depth and pull out stubbles of the previous crop. This operation will also bring some insect pests to the soil surfaces which are killed due to exposure. Then two to three times the soil must be ploughed by cultivator. Then after this rotavator is used to make powder the soil and then make ridges by row ridger.

Transplanting: The seedling becomes ready for transplanting at the end of February, when these attain height of 4-5 inches and have 5-6 leaves. The transplanting date depends upon the intensity of frost in the area [8]. In Chakdarra and Shergarh area the transplanting is done 1-2 weeks earlier than in Charsadda and Peshawar. So in Chakdarra and Shergarh area the transplanting begins in the last week of February.

Ridge Making: The farmers have adopted plantation on ridges because it is economical and requires less quantity of irrigation water. Also making a high row ridge improves drainage, which aids in disease management and decrease drowning of tobacco plants in the field. It increases better roots growth and proper and timely utilization of fertilizer elements [9].

Proper Spacing and Number of Plants per Hectare: The number of plants that should be planted to the hectare as well as their arrangement on the field has an effect on the yield, quality as well as other cultural practices of tobacco

crop. As there is a considerable variation due to the type of tobacco grown so the spacing of the plant in the field differs widely [10]. A wide range of spacing is used in the Chakdarra and Shergarh areas; however, the usual practice among the farmers is 3x2 feet. They kept the distance between rows as 3 feet and between plants as 2 feet. However, the spacing requirement of plants depends upon the fertility of the soil and the type of machinery used. The row and within row to row and plant to plant distance should be reduced where, plant food is abundant in the soil. Therefore, the spacing of plants should be arranged in such a manner to permit easy cultivation, hoeing, spraying and picking of leaves.

Fertilization: Tobacco is an exhaustive crop and required adequate manuring for maximum production of good quality leaf. It is very important that the supply of various essential elements will be balanced otherwise the stimulation action of more abundant nutrient will intensify the deficiency effect of a lesser supply of other nutrient element [11].

Time and Method of Application of Fertilizers: Most of our farmer use N.P.K, which they buy from the Pakistan tobacco company depots. It is applied in the soil just after one week of transplantation [12]. The farmers dig holes in the soil with the help of kudal or woody sticks. These holes are made at one or both sides of tobacco plants. Each hole is 3-4 inches at a distance from the tobacco plant and 4-5 inches deep and 28 grams of N.P.K when exposed to air, the nitrogen in it start volatilization in the form of NH_3 e.g. Ammonia gas. However this distance and depth of holes for in N.P.K and doze of N.P.K/plant varies among different areas depend upon the condition of soil in terms of fertility.

This activity was suggested by the PTC leaf department because deep band application (4-5 inches) should produce good yield and quantity more consistently than broad cast or shallow band application, regardless of the fertilizer type. The ratio of N.P.K is 10:20:20. The recommended level of N.P.K from PTC one hectare plantation is 8 bags. The recommended fertilizer level in Shergarh area is 45:80:80.

Instead of N.P.K other fertilizers like Ammonium Nitrate, Ammonium Sulphate, Nitrophos, Urea and Super Phosphate and DAP are also used by the farmers at different times, in different quantities and at different method of application.

Crop Rotation and Cropping Pattern: Most of the important diseases that occur every year are caused by organisms that persist in the soil and can reproduce only on tobacco and a few other plants. Without tobacco or one of the other host plants, populations of the disease-causing organisms are reduced [13]. Therefore crop rotation must be emphasized in planning any disease management programme, because crop rotation removes a suitable plant on which pest can feed, the longer the rotation, the more beneficial it will be. Thus a four-year rotation (three alternate crops between tobaccos) is more effective than a three or two years rotation. A two year rotation (one alternate crop between crops of tobacco) significantly reduces disease and is far better than continuous culture. The cropping pattern of our farmers is mostly of two years rotation is given below.

- Maize-Tobacco-Maize-Tobacco
- Vegetables-tobacco-vegetables-tobacco
- Sugarcane-tobacco-maize

Most of the Formers Adopt the First Cropping Pattern in Their Fields.

Time and Amount of Irrigation: Irrigation is required when large amount of water is removed from the active root zone. Time and frequency of irrigation largely defends on rainfall, soil type, temperature and other factors which effect availability of moisture [14]. The moisture requirement of plants also varies with growth stages and watering specificity is most essential in the following growth stages. At transplanting the main objective is survival and establishment of seedling to get a good crop stand. Therefore one irrigation should be given before transplantation to prevent clod and crust formation. After transplanting, irrigation is done to avoid leaf brushing and wilting of young seedlings. The irrigation at this stage should be light and given at interval of 3-4 days. In the next stage from establishment of the plants to knee high stage, the decrease in the soil moisture even to a level of visible wilting of plants will not materially affect either yield or quality.

The water should be applied when the soil moisture has become so low that plant show an obvious suffering. During this period too, irrigation given should be light to avoid drowning of the plants. The most critical period of plant growth is between knee high and full bloom stage. As during this stage the crop grow rapidly so one should not wait for wilting but should judge from the soil surface

and its moisture content and apply irrigation rapidly. After the attainment of full bloom light irrigation is required till maturity. Toward the harvest rains and wind storms are common, therefore care should be taken, while irrigating the fields, that plants do not become liable to lodging and growing. The cop should invariably be irrigated after each picking. So in the six month growth period of tobacco plant, it needs 16-20 irrigation depending on soil and climatic conditions.

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